

1. A method of compressing data, the method including the steps of:
applying a transform to the data to produce transformed data having a series of
parts;

entropy encoding the magnitude of the transformed data of at least one of said
5 parts based on the magnitude of the surrounding transformed data; and
separately encoding the value of said transformed data.

2. A method as claimed in claim 1, wherein said entropy encoding utilizes the
number of non-zero coefficients surrounding a spatial location of a corresponding
10 transformed data value.

3. A method as claimed in claim 2, wherein the surrounding values utilized are
previously entropy encoded values adjacent to a current spatial location of the
corresponding transformed data value.

4. A method as claimed in claim 1, wherein said transforming step further
includes quantizing transformed portions of said data to integer values.

5. A method as claimed in claim 4, wherein said integer values include a sign bit
and a predetermined number of coefficient bits.

6. A method as claimed in 1, wherein said transform includes wavelet
transforming the data.

7. A method as claimed in claim 6, wherein said parts include each of the sub-
band components of the wavelet transform which are separately entropy encoded.

8. A method as claimed in ^{claim 6}~~claims 6 or 7~~, wherein the lowest frequency sub-band
component is separately encoded.

9. A method as claimed in claim 1, wherein said data includes image data
describing an image.

10. A method as claimed in claim 1, wherein said magnitude encoding includes
encoding the number of leading zeros in transformed data values.

11. A method of decompressing data, the method including the steps of

entropy decoding a portion of the data to generate the magnitudes of transform data based on the magnitudes of surrounding, previously entropy decoded, transformed data; and

5 separately decoding another portion of the data to generate the values of said transformed data; and

applying an inverse transform to the transform data to generate decompressed data.

12. A method as claimed in claim 11, wherein said entropy decoding utilizes the
10 number of non-zero coefficients surrounding a spatial location corresponding to a transformed data value.

13. A method as claimed in claim 12, wherein the surrounding values utilized are
15 previously entropy decoded values adjacent to a current spatial location corresponding to a transformed data value.

14. A method as claimed in claim 11, wherein said transforming step further includes inverse quantizing transformed portions of said data.

20 15. A method as claimed in 11, wherein said inverse transform includes inverse wavelet transforming the data.

16. A method as claimed in claim 15, wherein said data include each of the sub-band components of the wavelet transform which are separately entropy encoded.

25 17. A method as claimed in claims 16, wherein the lowest frequency sub-band component is separately decoded.

18. A method as claimed in claim 11, wherein said data includes image data
30 describing an image.

19. A method as claimed in claim 11, wherein said magnitude encoding includes
20 encoding the number of leading zeros in transformed data values.

20. An apparatus for compressing data, the apparatus including:
35 transform means for applying a transform to the data to produce transformed data having a series of parts;

entropy encoding means for entropy encoding the magnitude of the transformed data of at least one of said parts based on the magnitude of the surrounding transformed data; and

encoding means for separately encoding the value of said transformed data.

5 ~~21.~~²⁰
~~22.~~ An apparatus as claimed in claim ~~21~~²⁰, wherein said entropy encoding means utilizes the number of non-zero coefficients surrounding a spatial location of a corresponding transformed data value.

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10 ~~23.~~²¹ An apparatus as claimed in claim ~~22~~²¹, wherein the surrounding values utilized are previously entropy encoded values adjacent to a current spatial location of the corresponding transformed data value.

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15 ~~24.~~²⁰ An apparatus as claimed in claim ~~21~~²⁰, wherein said transform means further includes quantizing means for quantizing transformed portions of said data to integer values.

25
20 ~~25.~~²³ An apparatus as claimed in claim ~~24~~²³, wherein said integer values include a sign bit and a predetermined number of coefficient bits.

26
25 ~~26.~~²⁰ An apparatus as claimed in ~~21~~²⁰, wherein said transform means includes wavelet transform means for wavelet transforming the data.

27
30 ~~27.~~²⁶ An apparatus as claimed in claim ~~26~~²⁶, wherein said parts include each of the sub-band components of the wavelet transform which are separately entropy encoded.

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A ~~28.~~^{claim 26} An apparatus as claimed in ~~claims 26 or 27~~^{claim 26}, wherein the lowest frequency sub-band component is separately encoded.

29
35 ~~29.~~²⁰ An apparatus as claimed in claim ~~21~~²⁰, wherein said data includes image data describing an image.

30
30 ~~30.~~²⁰ An apparatus as claimed in claim ~~21~~²⁰, wherein said magnitude encoding includes encoding the number of leading zeros in transformed data values.

31
35 ~~31.~~²⁰ An apparatus for decompressing data, the apparatus including;

entropy decoder means for entropy decoding a portion of the data to generate the magnitudes of transform data based on the magnitudes of surrounding, previously entropy decoded, transformed data; and

decoder means for separately decoding another portion of the data to generate
5 the values of said transformed data; and

inverse transform means for applying an inverse transform to the transform data to generate decompressed data.

241
32. An apparatus as claimed in claim ³⁰31, wherein said entropy decoder utilizes the
10 number of non-zero coefficients surrounding a spatial location corresponding to a transformed data value.

241
33. An apparatus as claimed in claim ³⁰32, wherein the surrounding values utilized are previously entropy decoded values adjacent to a current spatial location
15 corresponding to a transformed data value.

241
34. An apparatus as claimed in claim ³⁰31, wherein said inverse transform means further includes inverse quantization means for inverse quantizing transformed portions of said data.

241
35. An apparatus as claimed in ³⁰34, wherein said inverse transform means includes inverse wavelet transform means for inverse wavelet transforming the data.

241
36. An apparatus as claimed in claim ³⁰35, wherein said data include each of the
25 sub-band components of the wavelet transform which are separately entropy encoded.

241
37. An apparatus as claimed in claim ³⁰36, wherein the lowest frequency sub-band component is separately decoded.

241
38. An apparatus as claimed in claim ³⁰34, wherein said data includes image data describing an image.

241
39. An apparatus as claimed in claim ³⁰31, wherein said magnitude encoding includes encoding the number of leading zeros in transformed data values.

241
40. A computer program product including a computer readable medium having recorded thereon a computer program for compressing data, the computer program product including:

transform means for applying a transform to the data to produce transformed data having a series of parts;

entropy encoding means for entropy encoding the magnitude of the transformed data of at least one of said parts based on the magnitude of the surrounding transformed data; and

encoding means for separately encoding the value of said transformed data.

42. A computer program product including a computer readable medium having recorded thereon a computer program for decompressing data, the computer program product including:

entropy decoder means for entropy decoding a portion of the data to generate the magnitudes of transform data based on the magnitudes of surrounding, previously entropy decoded, transformed data; and

decoder means for separately decoding another portion of the data to generate the values of said transformed data; and

inverse transform means for applying an inverse transform to the transform data to generate decompressed data.

43. A method of compressing data, the method including the steps of:

(a) applying a transform to the data to produce a plurality of transform coefficients, wherein each transform coefficient is expressible by a code representation including a plurality of symbols;

(b) entropy encoding one of said symbols, not previously entropy coded, of a current transform coefficient based on a context of surrounding symbols;

(c) repeating step (b) a predetermined number of times for the current transform coefficient; and

(d) processing another transform coefficient in accordance with steps (b) and (c).

44. A method as claimed in claim 43 wherein said context of surrounding symbols is determined from previously encoded coefficients.

45. A method as claimed in claim 43, wherein the method includes a further step of quantising said transform coefficients.

46. A method as claimed in claim 43, wherein said predetermined number of times is consistent with an encoding of substantially all of the symbols of the current transform coefficient.

^{u1}
~~47~~ A method as claimed in claim ~~43~~, wherein said context is determined from an arrangement of surrounding symbols.

^{u6}
5 ~~48~~ A method as claimed in claim ~~47~~, wherein said surrounding symbols are previously encoded symbols.

^{u7}
~~49~~ A method as claimed in claim ~~48~~, wherein said context includes a first flag which indicates whether or not a most significant symbol of the current transform coefficient has been encoded.

^{u8}
~~50~~ A method as claimed in claim ~~49~~, wherein said context includes a second flag which indicates whether or not a most significant symbol, of at least one transform coefficient spatially adjacent to the current transform coefficient, has been encoded.

^{u9}
15 ~~51~~ A method of compressing data including the steps of:

a) applying a transform to the data to produce a plurality of transform coefficients, wherein each transform coefficient is expressible by a binary code representation having a plurality of bits;

20 b) entropy encoding one of said bits, not previously entropy coded, of a current transform coefficient based on a context of surrounding bits;

c) repeating step b) a predetermined number of times the current transform coefficient; and

d) processing another transform coefficient in accordance with steps b) and c).

^{u9}
~~52~~ A method as claimed in claim ~~51~~, wherein said context of surrounding bits is determined from previously encoded coefficients.

^{u9}
30 ~~53~~ A method as claimed in claim ~~51~~, wherein the method includes a further step of quantising said transform coefficients.

^{u9}
~~54~~ A method as claimed in claim ~~51~~, wherein said context of surrounding bits includes information as to whether or not a most significant bit of the current transform coefficient has been encoded.

^{u9}
35 ~~55~~ A method as claimed in ~~claim 51 or 54~~, wherein said context of surrounding bits includes information as to whether or not a most significant bit of at least one

transform coefficient spatially adjacent, to the current transform coefficient, has been encoded.

5 ~~51~~ A method as claimed in claim ~~51~~⁴⁹, wherein said transform coefficients are represented in a bit-plane representation and said surrounding bits are bits in a current bit-plane.

~~55~~ A method as claimed in ~~claim 43 or 51~~^{claim 43}, wherein said entropy encoding is performed by an arithmetic coder.

10 ~~58~~ A method as ~~claimed 43 or 51~~^{claim 43}, wherein said transform is a Discrete Wavelet Transform.

~~59~~ A method of decompressing data, the method including the steps of:
15 (a) entropically decoding said data to generate a symbol of a current transform coefficient based on a context of surrounding symbols;
(b) repeating step (a) a predetermined number of times for the current transform;
(c) generating another transform coefficient in accordance with steps (a) and
20 (b); and
(d) applying an inverse transform to the transform coefficients to produce data.

~~60~~ A method as claimed in claim ~~59~~⁵⁷, wherein said context of surrounding symbols is determined from previously encoded coefficients.

25 ~~61~~ A method as claimed in claim ~~59~~⁵⁷, wherein the method includes a further step of inverse quantising said transform coefficients.

~~62~~ A method as claimed in claim ~~59~~⁵⁷, wherein said predetermined number of times is consistent with an decoding of substantially all of the symbols of the current transform coefficient.

~~63~~ A method as claimed in claim ~~59~~⁵⁷, wherein said context is determined from an arrangement of surrounding symbols.

35 ~~64~~ A method as claimed in claim ~~63~~⁶¹, wherein said surrounding symbols are previously decoded symbols.

65. A method as claimed in claim ~~64~~, wherein said context includes a first flag which indicates whether or not a most significant symbol of the current transform coefficient is encoded or decoded.

66. A method as claimed in claim ~~66~~, wherein said context includes a second flag which indicates whether or not a most significant symbol, of at least one transform coefficient spatially adjacent to the current transform coefficient, is encoded or decoded.

67. A method of decompressing data, the method including the steps of:

(a) entropically decoding said data to generate a bit of a current transform coefficient based on a context of surrounding bits;

(b) repeating step (a) a predetermined number of times for the current transform;

(c) generating another transform coefficient in accordance with steps (a) and (b)

(d) applying an inverse transform to the transform coefficients to produce data.

68. A method as claimed in claim ~~67~~, wherein said context of surrounding bits is determined from previously encoded coefficients.

69. A method as claimed in claim ~~67~~, wherein the method includes a further step of inverse quantising said transform coefficients.

70. A method as claimed in claim ~~67~~, wherein said context of surrounding bits includes information as to whether or not a most significant bit of the current transform coefficient is encoded or decoded.

71. A method as claimed in ~~claim 67 or 70~~, wherein said context of surrounding bits includes information as to whether or not a most significant bit of at least one transform coefficient spatially adjacent, to the current transform coefficient, is encoded or decoded.

72. A method as claimed in ~~claim 67~~, wherein said transform coefficients are represented in a bit-plane representation and said surrounding bits are bits in a current bit-plane.

1 ~~73~~ A method as claimed in ~~claim 59 or 67~~, wherein said entropy decoding is performed by an arithmetic coder.

2 ~~74~~ A method as ~~claimed 59 or 67~~, wherein said inverse transform is a inverse
5 Discrete Wavelet Transform.

3 ~~75~~ An apparatus for compressing data, the apparatus including:

transform means for applying a transform to the data to produce a plurality of transform coefficients, wherein each transform coefficient is expressible by a code representation including a plurality of symbols;

entropy encoder means for entropy encoding one of said symbols, not previously entropy coded, of a current transform coefficient based on a context of surrounding symbols;

repetition means for repeating the operations of the entropy encoder means a
15 predetermined number of times for the current transform coefficient; and

processor means for processing another transform coefficient in accordance with the operations of the entropy encoder means and repetition means.

20 ~~76~~ An apparatus as claimed in claim ~~75~~, wherein said context of surrounding symbols is determined from previously encoded coefficients.

25 ~~77~~ An apparatus as claimed in claim ~~75~~, wherein the apparatus further includes quantizing means for quantizing said transform coefficients.

30 ~~78~~ An apparatus as claimed in claim ~~75~~, wherein said predetermined number of times is consistent with an encoding of substantially all of the symbols of the current transform coefficient.

35 ~~79~~ An apparatus as claimed in claim ~~75~~, wherein said context is determined from an arrangement of surrounding symbols.

~~80~~ An apparatus as claimed in claim ~~75~~, wherein said surrounding symbols are previously encoded symbols.

~~81~~ An apparatus as claimed in claim ~~80~~, wherein said context includes a first flag which indicates whether or not a most significant symbol of the current transform coefficient has been encoded.

80.
92. An apparatus as claimed in claim 92, wherein said context includes a second flag which indicates whether or not a most significant symbol, of at least one transform coefficient spatially adjacent to the current transform coefficient, has been encoded.

81.
93. An apparatus for compressing data including:
transform means for applying a transform to the data to produce a plurality of transform coefficients, wherein each transform coefficient is expressible by a binary code representation having a plurality of bits;

81.
94. entropy encoder means for entropy encoding one of said bits, not previously entropy coded, of a current transform coefficient based on a context of surrounding bits;

81.
95. repetition means for repeating the operation of the entropy encoder a predetermined number of times for the current transform coefficient; and

81.
96. processor means for processing another transform coefficient in accordance with the operations of the entropy encoder means and repetition means.

81.
97. An apparatus as claimed in claim 93, wherein said context of surrounding bits is determined from previously encoded coefficients.

81.
98. An apparatus as claimed in claim 93, wherein the apparatus includes quantising means for quantising said transform coefficients.

81.
99. An apparatus as claimed in claim 93, wherein said context of surrounding bits includes information as to whether or not a most significant bit of the current transform coefficient has been encoded.

81.
100. An apparatus as claimed in claim 93, wherein said context of surrounding bits includes information as to whether or not a most significant bit of at least one transform coefficient spatially adjacent, to the current transform coefficient, has been encoded.

81.
101. An apparatus as claimed in claim 93, wherein said transform coefficients are represented in a bit-plane representation and said surrounding bits are bits in a current bit-plane.

81.
102. An apparatus as claimed in claim 93, wherein said entropy encoding is performed by an arithmetic coder.

88
A 100. An apparatus as ~~claimed 75 or 93~~^{claim 73}, wherein said transform is a Discrete Wavelet Transform.

89
101. An apparatus for decompressing data, the apparatus including:
5 entropy decoder means for entropying decoding said data to generate a symbol of a current transform coefficient based on a context of surrounding symbols;
repetition means for repeating the operation of the entropy decoder means a predetermined number of times for the current transform coefficient;
generation means for generating another transform coefficient in accordance with the operations of the entropy decoder means and the repetition means; and
10 inverse transform means for applying an inverse transform to the transform coefficients to produce data.

90
102. An apparatus as claimed in claim ~~101~~⁸⁹ wherein said context of surrounding symbols is determined from previously decoded coefficients.

91
103. An apparatus as claimed in claim ~~101~~⁸⁹, wherein the method includes inverse quantisation means for inverse quantising said transform coefficients.

92
20 104. An apparatus as claimed in claim ~~101~~⁸⁹, wherein said predetermined number of times is consistent with a decoding of substantially all of the symbols of the current transform coefficient.

93
25 105. An apparatus as claimed in claim ~~101~~⁸⁹, wherein said context is determined from an arrangement of surrounding symbols.

94
106. An apparatus as claimed in claim ~~105~~⁹³, wherein said surrounding symbols are previously decoded symbols.

95
30 107. An apparatus as claimed in claim ~~106~~⁹⁴, wherein said context includes a first flag which indicates whether or not a most significant symbol of the current transform coefficient is encoded or decoded.

96
35 108. An apparatus as claimed in claim ~~107~~⁹⁵, wherein said context includes a second flag which indicates whether or not a most significant symbol, of at least one transform coefficient spatially adjacent to the current transform coefficient, is encoded or encoded.

97.
109.

An apparatus for decompressing data, the apparatus including:
entropy decoder means for entropically decoding said data to generate a bit of a
current transform coefficient based on a context of surrounding bits;
repetition means for repeating the operation of the entropy decoder means a
predetermined number of times for the current transform coefficient;
generation means for generating another transform coefficient in accordance
with the operations of the entropy decoder means and the repetition means; and
inverse transform means for applying an inverse transform to the transform
coefficients to produce data.

98.
110.

An apparatus as claimed in claim 109, wherein said context of surrounding bits
is determined from previously decoded coefficients.

99.
111.

An apparatus as claimed in claim 109, wherein the apparatus includes inverse
quantisation means for inverse quantising said transform coefficients.

100.
112.

An apparatus as claimed in claim 109, wherein said context of surrounding bits
includes information as to whether or not a most significant bit of the current transform
coefficient is encoded or decoded.

101.
113.

An apparatus as claimed in claim 109 or 112, wherein said context of
surrounding bits includes information as to whether or not a most significant bit of at
least one transform coefficient spatially adjacent, to the current transform coefficient, is
encoded or decoded.

102.
114.

An apparatus as claimed in claim 109, wherein said transform coefficients are
represented in a bit-plane representation and said surrounding bits are bits in a current
bit-plane.

103.
115.

An apparatus as claimed in claim 101 or 109, wherein said entropy decoding is
performed by an arithmetic coder.

104.
116.

An apparatus as claimed in claim 101 or 109, wherein said inverse transform is a
inverse Discrete Wavelet Transform.

105.
117.

A computer program product including a computer readable medium having
recorded thereon a computer program for compressing data, the computer program
product including:

transform means for applying a transform to the data to produce a plurality of transform coefficients, wherein each transform coefficient is expressible by a code representation including a plurality of symbols;

entropy encoder means for entropy encoding one of said symbols, not previously entropy coded, of a current transform coefficient based on a context of surrounding symbols; and

repetition means for repeating the operations of the entropy encoder means a predetermined number of times for the current transform coefficient; and

processor means for processing another transform coefficient in accordance with the operations of the entropy encoder means and repetition means.

8. A computer program product including a computer readable medium having recorded thereon a computer program for compressing data, the computer program product including:

transform means for applying a transform to the data to produce a plurality of transform coefficients, wherein each transform coefficient is expressible by a binary code representation having a plurality of bits;

entropy encoder means for entropy encoding one of said bits, not previously entropy coded, of a current transform coefficient based on a context of surrounding bits;

repetition means for repeating the operation of the entropy encoder a predetermined number of times the current transform coefficient; and

processor means for processing another transform coefficient in accordance with the operations of the entropy encoder means and repetition means.

9. A computer program product including a computer readable medium having recorded thereon a computer program for decompressing data, the computer program product including:

entropy decoder means for entropy decoding said data to generate a symbol of a current transform coefficient based on a context of surrounding symbols;

repetition means for repeating the operation of the entropy decoder means a predetermined number of times for the current transform coefficient;

generation means for generating another transform coefficient in accordance with the operations of the entropy decoder means and the repetition means; and

inverse transform means for applying an inverse transform to the transform coefficients to produce data.

108
120. A computer program product including a computer readable medium having recorded thereon a computer program for decompressing data, the computer program product including:

5 entropy decoder means for entropying decoding said data to generate a bit of a current transform coefficient based on a context of surrounding bits;

repetition means for repeating the operation of the entropy decoder means a predetermined number of times for the current transform coefficient;

generation means for generating another transform coefficient in accordance with the operations of the entropy decoder means and the repetition means; and

10 inverse transform means for applying an inverse transform to the transform coefficients to produce data.